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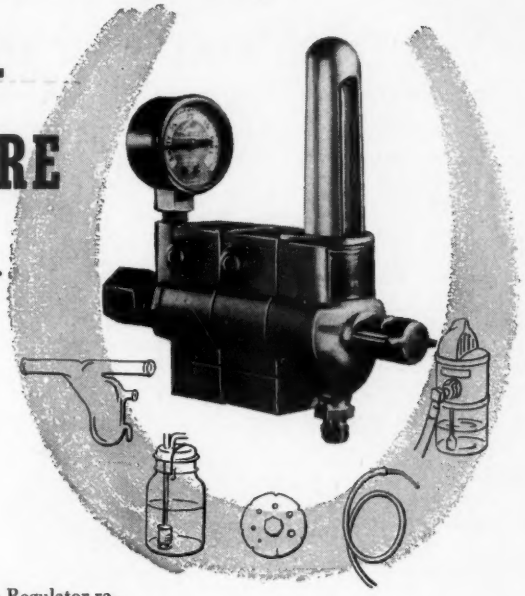

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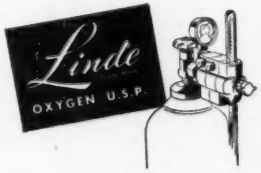

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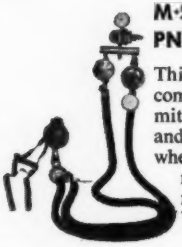

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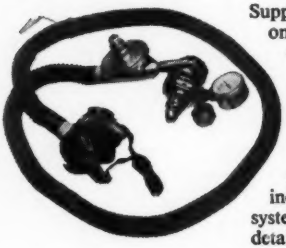

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Volume One Number Two

AMERICAN ASSOCIATION OF INHALATION THERAPISTS

"Inhalation Therapy"

"Inhalation Therapy" is the official publication of the American Association of Inhalation Therapists, an organization of therapy technicians working in hospitals and for firms providing emergency therapy service. The Association is sponsored by the American College of Chest Physicians. Contents include news and information pertinent to the profession including medical research, operative techniques, and practical administration.

CONTENTS

Editorial 6
Editorial Policy
Artificial Respiration via the Uncuffed Tracheostomy Tube
Dr. E. T. Mörch, Dr. G. A. Saxton, Jr., Gareth Gish 7
Among Our Contributors 14
An Adapter for Positive Pressure via Tracheostomy
Gareth Gish 15
Addition of Dead Space to Produce Hyperventilation for Prophylaxis of Atelectasis
Drs. S. I. Schwartz and V. A. Dale 16
A Simple Test — Will Your Tents Pass It?
John R. Greene 19
Know Your Directors 20
Inhalation Therapist's Holiday
Robert L. Kruse 22
Association News Briefs 26
Inhalation Therapy Abstracts 28

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Editorial Policy

OUR EDITORIAL staff members are responsible for being as accurate as their sources of information permit, and for selecting topics worthy of discussion and presenting them in a style sufficiently provocative to make readers think about the subjects. But since no one of us can be the final authority on any issue, any more than the Association itself can, opinions expressed in our editorials or articles must *not* be construed to be those of the AAIT. They are those of the author whose name or initials are signed to the piece.

Editorials appearing in newspapers are usually not signed, and readers have come to assume therefore that opinions expressed in a given paper are those of the owner or publisher. This is, as a matter of fact, usually true, and in instances where opinions are at variance with those of the owner or publisher, the editorials are signed.

A scientific or professional journal is a different sort of venture from a newspaper. No journal editor when he writes an editorial is expressing the view of Science or of Medical Authority or of any scientific or professional organization—he cannot express more than his own view unless he has held a meeting with a board of directors or associate editors and they have concluded together on what it is he is to write. In this special case, he may be speaking for the organization of which the journal is the official organ, but otherwise he is not.

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JAMES F. WHITACRE, *Editor*

ARTIFICIAL RESPIRATION VIA THE UNCUFFED TRACHEOSTOMY TUBE

By ERNST T. MÖRCH, M.D., PhD., GEORGE A. SAXTON, JR., and GARETH B. GISH, M. S.*

IN THE PAST, intermittent positive-pressure breathing via the tracheostomy tube has been used in patients with acute anterior poliomyelitis in one of two ways: (1) as a supplement to other respiratory equipment (tank respirator, chest respirator, or rocking bed) or (2) as the only means of artificial respiration. The former application has been practiced chiefly in the United States,[1] whereas the latter has been practiced in a few cases in the United States and is the technique commonly used in the Scandinavian countries.[2]

For the administration of intermittent positive-pressure breathing as the only means of artificial respiration, an airtight system has in the past been used almost exclusively except in the series presented here. This is commonly achieved by the use of an inflatable cuff around the distal part of the tracheostomy tube, a technique used for the first time on a wide scale during the 1952 epidemic in Copenhagen (fig. 1). At that time some 300 patients were treated by intermittent positive-pressure breathing given manually over three months, day and night, until mechanical devices were made available. Such devices were made as a result of the epidemic, of which the Engström respirator is the most commonly used in Europe.[3] This respirator requires a closed system and does not work properly if a leak occurs.

Types of Tracheostomy Tubes

Cuffed Tracheostomy Tube. — Use of the cuffed tracheostomy tube is disadvantageous in many respects, and it is said to be attended by "all sorts of complications."[4] 1. The soft rubber tracheostomy tube with the inflatable cuff is much more difficult to insert into the right place in the trachea than the silver tube. The cuffed tube may go into a via falsa outside the trachea in the loose connective tissue during the first days after the operation; it may not be inserted far enough; or it may be inserted too far, so that it enters the right main bronchus. 2. The cuff offers resistance on insertion and may rupture or be dislocated during in-

*Reprinted from the March 10 (1956) JAMA.

1. The Diagnosis and Treatment of the Acute Phase of Poliomyelitis and Its Complications, Bower, A. G., editor, Baltimore, Williams & Wilkins Company, 1954.

2. Lassen, H. C. A.: Preliminary Report on 1952 Epidemic of Poliomyelitis in Copenhagen with Special Reference to Treatment of Acute Respiratory Insufficiency, Lancet 1:37, 1953.

3. Engström, C. G.: Respirator Designed According to a New Principle, Svenska läk.-tidning. 50:545, 1953.

4. Anderson, E. W., and Ibsen, B.: The Anaesthetic Management of Patients with Poliomyelitis and Respiratory Disease, Brit. M. J. 1:786, 1954.

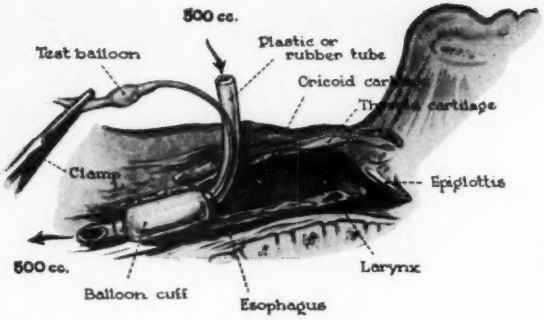

Fig. 1. — Cuffed tracheostomy tube must be airtight in order that all volume delivered to tube enters lungs.

sertion. 3. The cuff in unreliable and treacherous because it is difficult to keep inflated. 4. The inflated cuff presses against the tracheal mucosa and may cause trauma or even necrosis.

Uncuffed Tracheostomy Tube.— The uncuffed tracheostomy tube for intermittent positive-pressure breathing was first used by one of us (E. T. M.) at the University of Kansas Medical Center in 1951, i.e., one year before the Danish epidemic.[5] It proved to be satisfactory if a high-capacity respirator were used, enabling one to compensate for the leak (fig. 2). At first it seemed unreasonable that such an open system could be effective, but as a matter of fact it worked satisfactorily in all cases tried. It has now been used successfully in approximately 22 patients as the only means of artificial respiration. In 10 cases of respiratory paralysis due to central nervous system trauma, neurosurgery, myasthenia gravis, or barbiturate poisoning, the patients have been treated effectively for a few days or weeks at a time. It has also been used continuously for longer periods of time in the management of 12 cases of respiratory paralysis due to poliomyelitis; the last 2 cases are presented here.

5. Baumeister, J.; Blood, M. J.; Marsh, A., and Roth, A.: Use of Tracheotomy, Intermittent Positive Pressure and Sedation in Treatment of Children Ill with Poliomyelitis, J. Kansas M. Soc. 53:280, 1952.

Report of Cases

Case 1.—A 13-year-old girl was admitted with acute anterior poliomyelitis. On the third day complete paralysis of all four extremities, intercostal muscles, and most of the diaphragm had developed. A chest respirator was tried but found to be inadequate. Marked acidosis developed as indicated by a venous carbon dioxide content of 36.1 mM. per liter and a pH of 7.15. On the fourth day tracheotomy was performed and intermittent positive-pressure breathing started by use of the Mörch piston respirator. From then on a mild respiratory alkalosis was maintained, except on the seventh day, when obstruction of the left bronchus occurred. On the 12th hospital day the chest respirator was again tried. After one hour the patient showed clinical signs of carbon dioxide narcosis, with hallucinations, circulatory collapse, and semicoma. She was returned to

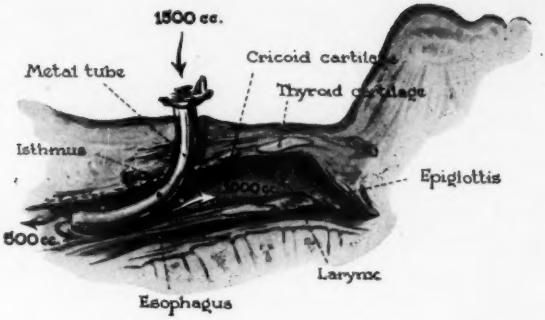

Fig. 2—Uncuffed tracheostomy tube permits some air to leak through larynx. This leak must be compensated for by delivery of larger volume to tube.

the Mörch respirator, and 30 minutes later she was conscious and quite well. The acidosis had disappeared, as indicated by a venous carbon dioxide content of 27.4 mM. per liter and pH 7.43 (fig. 3).

Small atelectases developed repeatedly and were treated by aspiration and postural drainage. The trachea and bronchi were aspirated and washed with 2 ml. of Alevaire (a mixture of 0.125% oxyethylated tertiary octylphenolformaldehyde polymer, 5% glycerin, 2% sodium bicarbonate, and water) in saline solution (1:4) several times per hour. The chest was auscultated several times daily and x-rays taken repeatedly. During the first month serous crusts formed rapidly around the tracheostomy tube, so that it had to be changed every 24 to 36 hours. On the 29th day a Monaghan positive-pressure respirator was utilized because the Mörch respirator was needed for another patient (case 2). On the 31st day she was able to breathe spontaneously for one-half to two minutes by means of the diaphragm; on the 35th day intercostal activity became evident. On the 59th day the patient was placed on a rocking bed for 20 minutes. On the 66th day she could breathe without any artificial aid. On the 71st day the tracheostomy tube was removed and respiration improved markedly. On the 78th day she started to stand and walk. On the 100th day she could get out of a wheel chair without assistance. She was discharged on the 103rd day.

Case 2.—A 30-year-old man was admitted with acute anterior poliomyelitis. Respiration was effortless at first; the vital capacity was 2 liters. Thirteen hours after admission paralysis of the arms progressed and difficulty in breathing increased; vital capacity was 1.4 liters. On the second day vital capacity equalled 0.6 liter, and the respiratory rate was 44 per minute. A Monaghan chest respirator was applied. Right sternocleidomastoid and trapezius muscles became paralyzed; no other evidence of bulbar involvement was found. Due to an unusual shape of the patient's chest, it was difficult to fit the chest respirator on him; in spite of padding, decubitus ulcer developed over the upper chest and all the way around the chest piece to the iliac crests.

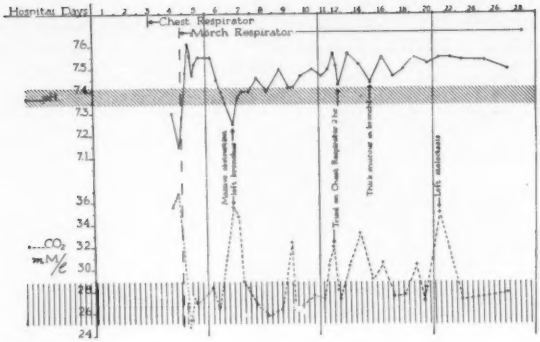

Fig. 3—pH and volume of carbon dioxide in venous blood of patient in case 1 during artificial respiration. Mild respiratory alkalosis maintained.

On the fifth day increasing respiratory difficulties developed; tracheotomy was performed, and breathing with a Mörch piston respirator was begun (fig. 4). Dyspnea then disappeared. Repeated episodes of atelectases, mainly in the left side, were treated by postural drainage by turning the patient from side to side and by washing with Alevairesaline solution (1:4) and aspiration. The air pumped into the lungs was humidified and oxygenated, which seemed to help considerably. Crusts formed outside and at the end of the tracheostomy tube so that it had to be changed one or more times daily for the first two months. By the 63rd day the patient was able to take 60 breaths spontaneously using the accessory muscles in the neck. On the 87th day he could breathe for 11 minutes. On the 96th day the vital capacity was 170 ml.; on the 117th day it was 290 ml., with a minute volume of 7.25 liters. On the 100th day the patient was placed on a rocking bed for a few minutes at a time. On the 163rd day his vital capacity was 350 ml. On the 183rd day he was transferred to a respirator center with complete paraplegia and essentially no function in the right leaf of the diaphragm or intercostal muscles. He was able to breathe spontaneously for one and one-quarter hours by means of his accessory respiratory muscles in the neck and the small residual in the left leaf of the diaphragm.

At the respirator center the Monaghan pressure attachment was substituted for the Mörch respirator. Then, in order to help him raise secretions by rocking, a Monaghan bellows was attached to a rocking bed so as to give him positive pressure when the feet were descending. The respiratory tract infection produced Pseudomonas aeruginosa on culture. The tracheobronchial secretions slowly diminished over a period of two weeks when 20 mg. of polymyxin was administered by aerosolization three times daily. This permitted closing the tracheostomy tube for long periods of time and finally removing it. Since then he has breathed much more easily and has required only a chest respirator or rocking bed, though the vital capacity remains 0.6 liter.

Respiratory Equipment

The following devices have been tried and found satisfactory for artificial respiration by intermittent positive-pressure breathing through an uncuffed tube.

Monaghan (Diaphragm) Positive-Pressure Attachement.—The Monaghan positive-pressure attachment consists of a metal housing divided by a diaphragm. The air from the Monaghan respirator moves the diaphragm up and down, forcing humidified and/or oxygenated air from the other side of the diaphragm into the patient. The stroke volume is indicated on a scale attached to the diaphragm and can be increased to 1.5 liters. Also, the pressure can be regulated.

Emerson Hand Bellows. — The Emerson hand bellows is a simple, portable device suitable for short-term use during transportation of the patient or during x-ray examination. The bellows are hung on the belt of the operator, so that the bellows can be pumped with one hand while the other holds the connection to the patient's tracheostomy or face mask.

Huxley Positive-Pressure Valve.—The Huxley positive-pressure valve is used in connection with the Huxley piston-type respirator. The pressure administered is indicated and controllable. Three limitations of this valve are that it sticks when humidity is used, it will operate only in the vertical position, and there is a large dead space in the tubing.

Bennett Self-Cycling Respirator.—The Bennett self-cycling respirator is the only "blower" type of machine that we have been able to adapt for intermittent positive-

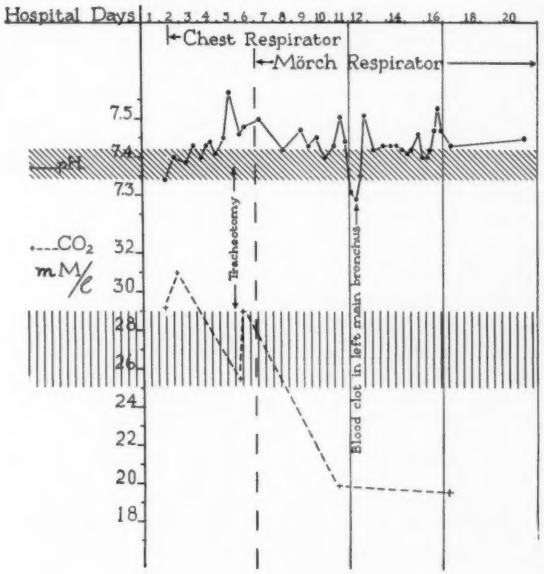

Fig. 4—pH and volume of carbon dioxide in venous blood of patient in case 2 during artificial respiration. Mild respiratory alkalosis maintained.

pressure breathing via the uncuffed tracheostomy tube. Pressure is indicated and can be controlled. Humidity can be administered.

Mörch Respirator.—The Mörch respirator consists of a motor-driven piston pump that drives air through a valve into the trachea. This valve allows the patient to exhale to the room while fresh air is sucked into the cylinder. The stroke volume can be increased to 4 liters but is commonly adjusted to about 0.5 to 1.5 liters. The air can be humidified and mixed with oxygen.

Tracheostomy

For tracheostomy an ordinary Chevalier Jackson silver tracheostomy tube is used without inflatable cuff. It is often a problem to adapt the positive-pressure device to the tracheostomy tube. We have used two methods that do not reduce airway diameter. 1. A rubber baby-bottle cap has proved effective. The inner cannula is pushed through a hole cut in the center of the cap. The part that usually slips over the bottle slips over the pressure tubing. This system originated in the department of pediatrics at Ann Arbor, Mich., and has been described elsewhere.[6] A flange may be soldered onto the inner cannula of the tracheostomy tube. This permits the adaptation of positive-pressure equipment directly without encroaching on the inner diameter of the system. Such tubes are commercially available.

Tube Size.—The larger the tracheostomy tube, the more likely it is that air will enter the lungs in preference to leaving through the nose and mouth during the positive-pressure phase of respiration (fig. 2). A certain amount of air will always "leak" up through the larynx, but this is desirable as a safety device against excessive pressure in the lungs and will blow secretions in the pharynx up toward the mouth. In the acute phase of disease, when tracheobronchial secretions are profuse, large tracheostomy tubes are necessary; e.g., sizes 6-8. However, as secretions decrease, smaller tubes have proved practical. The tube must be big enough to accommodate easily an effective suction catheter.

Valves.—An expiratory valve is usually used in the tubing between the respirator and the patient in order to permit air to leave the patient's lungs via the tracheostomy tube while the respirator is filling with fresh air. Such a valve is usually of the pressure-balanced type resembling an inflatable rubber mushroom. However, one of us (E. T. M.) has developed a simple plastic float valve that does not stick in the presence of detergent aerosols as the pressure-balanced type does.

Humidity.—When positive-pressure breathing through the tracheostomy tube is being used as a means of artificial respiration, humidity is essential because the normal air-conditioning process in the nose is bypassed. Most commercially available humidifiers are inadequate. The Hi-Flow nebulizer proved satisfactory in two cases. In some cases distilled water is sufficient for the aerosol. In other cases, bronchial secretions may be viscid and large mucous plugs life-threat-

6. Gish, G.: Connection of Tracheotomy Tubes, Am. A. Inhalation Therapists Bull. **8**:1, 1955. (Reprinted in this issue of Inhalation Therapy.)

ening. In such cases, diluted Alevaire was used as a detergent and found to be quite effective in preventing these difficulties.

Adequacy of Ventilation. — The rib cage must move. If no respiratory excursions are observed, then there is ventilatory insufficiency and the cause must be located. The most common cause of failure is secretions, either in liquid form or as a "plug." They may be heard easily at the expiratory valve between the positive-pressure device and the tracheostomy tube and must be removed by suction. Also, in contrast to patients in the tank respirator, it is easy to palpate, percuss, and listen to the chest. If the patient talks a great deal, during which time the vocal cords are drawn apart, much of the positive pressure may be wasted and too little air enters the lungs. The stroke volume of the respirator must be increased to compensate for this leak. It is unnecessary for the patient to make any conscious efforts to close the glottis for intermittent positive-pressure breathing to be effective via the uncuffed tube. It works as well when the patient is asleep as when he is conscious. Cyanosis should never be allowed, because it is usually a sign of grossly inadequate ventilation, though it may be caused by impaired intrapulmonary function.

The total carbon dioxide content and pH of venous blood can now be determined in many hospitals and should be kept at about normal levels, if the serum sodium and chloride are known to be normal. A mild respiratory alkalosis induced passively is without danger; in fact, it is desirable in the acute phase of poliomyelitis. In the convalescent phase of poliomyelitis slight respiratory acidosis is justifiable because it helps in "weaning" the patient from the respiratory equipment. Alveolar air and arterial blood have been analyzed for gas tensions in a few patients. If such research techniques are available, they can be of immediate clinical value.

Comment

In comparison with the tank respirator the following advantages of this system have been noted: 1. The patient can be examined easily, especially his chest, and the blood pressures can be checked more easily. 2. Medical and nursing care are facilitated. Intravenous and infusions and catheterization of the urinary bladder can be carried out more easily; the patient may be turned from side to side or prone, and better skin care can be achieved. 3. Physical therapy is facilitated because the patient is more accessible and greater range of motion is possible. 4. Equipment is smaller and more easily managed by untrained personnel than is the tank respirator. 5. This system is less likely to produce gastric dilatation. 6. Sedatives and narcotics may be given.

The chief disadvantage is the necessity of a tracheostomy. The hazards and complications of tracheostomy are such as to deter one from performing the operation solely to permit ventilation by intermittent positive-pressure breathing via the tracheostomy tube. However, when a tracheostomy is required in a patient with respiratory paralysis, this would seem to be the logical system to use for artificial respiration in order to eliminate the tank respirator. A second disadvantage of this system

is the possibility that the tubing from the respirator to the patient may disconnect itself. This is analogous to the possibility for leaks to develop in the tank respirator. Such accidents can be prevented by the proper mechanical safeguards. An alarm that rings when pressure is not developed intermittently in the tubing to the patient has been used to warn the nursing staff of such accidental disconnections.

Summary and Conclusions

In an effort to determine the proper place of intermittent positive-pressure breathing through the uncuffed tracheostomy tube, various respiratory devices were tried. One was designed and built in a university laboratory; the rest are commercially available. From the point of view of respiratory physiology, there is no significant difference between breathing by intermittent positive-pressure at the upper airway and intermittent negative-pressure around the body.[7] No circulatory complications have been observed. Thus, it would seem logical to make use of the greater facility for patient management given by intermittent positive-pressure breathing via the uncuffed tracheostomy tube when artificial respiration is needed in a patient with a tracheostomy.

7. Whittenberger, J. L.: Medical Progress: Resuscitation and Other Uses of Artificial Respiration: Part 1, New England J. Med. **251**:775, 1954; Part 2, ibid. **251**:816, 1954.

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An Adapter for Positive Pressure via Tracheostomy

By GARETH B. GISH

THERE ARE NUMEROUS devices on the market for positive pressure breathing, and these may function as positive pressure on inspiration, expiration or during the entire respiratory cycle. It has been found difficult to adapt some of these devices to a tracheostomy tube.

An adapter may be used with many of the devices that are available for positive pressure administration. One of the methods commonly employed is that of inserting a piece of plastic tubing of appropriate size into the lumen of the inner cannula of the tracheostomy tube. The pressure device is then connected to this plastic tubing. The manner in which this is accomplished is simple, and shows one of the ways of adaptation to different sizes of tracheostomy tubes.

The objection to this technique, however, is the significantly increased effort required to breathe through the narrowed airway. This increased resistance, along with those already inherent in the circuits of the positive pressure devices, imposes an additional workload on the lung structures of the patient.

To overcome this reduced diameter of the inner cannula, we have used a simple means of adaptation readily available at any drug store. This item is cheap and can be used many times before it has to be replaced. It is a baby bottle cap of amber latex rubber, made by the Davol Manufacturing Company, and obtainable under the following item number and description: *150, nursing bottle cap.*

To use this cap with a tracheostomy tube, it is necessary to cut a small hole in the top of the cap and insert the inner cannula of the tracheostomy tube through this opening from the under side of the cap, so that the flanges on the inner cannula are inside the cap. Remove the obturator from the tracheostomy tube and insert the inner cannula with the baby bottle cap attached, into the tracheostomy tube. The unit is then ready for placement in the patient. By the use of curved adapters or a right angle with a small piece of rubber tubing of the appropriate diameter, this cap unit may be used to adapt most of the positive pressure breathing devices to any size tracheostomy tube.

The advantages of this technique are: (1) No decrease in diameter of the airway; hence, no increase in resistance to breathing. (2) It may be easily detached from the pressure device for cleansing of the tracheobronchial tree. (3) The adaptive unit may be easily cleaned and sterilized. (4)The positive pressure equipment may easily be re-attached to the tracheostomy tube.

The writer wishes to thank Dr. George Saxton of the University of Illinois Research and Educational Hospital Respiratory Center for the suggestion of using the baby bottle cap. Dr. Saxton informs me that he first saw it done in the Pediatric Department of the University of Michigan at Ann Arbor.

Addition of Dead Space to Produce

HYPERVENTILATION

for Prophylaxis of Atelectasis

By SEYMOUR I. SCHWARTZ, M.D. and W. ANDREW DALE, M.D., F.A.C.S.

ATELECTASIS is recognized as a common and often dangerous complication, occurring not only after surgery but also in other situations in which tracheobronchial secretions are not properly cleared. The prophylactic effect of hyperventilation induced by carbon dioxide breathing has been known for many years. The use of a paper bag into which the patient rebreathes and accumulates CO_2 is a common method of stimulating greater tidal volumes. However, the small size of the bags ordinarily used, as well as the constant leaks due to imperfect fitting about the face, makes this method inadequate. Rebreathing with 5 or 10% CO_2 mixtures, using a face contour mask, effectively increases aeration of the lung, but entails bulky apparatus and increased cost.

Recently we have achieved hyperventilation by simply extending the patient's normal respiratory dead space with a rubber tube. This results in an increased alveolar pCO_2*, and subsequently an increased *arterial* pCO_2, which by central nervous system stimulation causes hyperventilation.

Studies were performed on normal personnel in order to select a standard dead space tube. The average tidal respiratory volume in these subjects was 590 cc, and test runs demonstrated an average increase of 770 cc in the tidal volume when breathing through the added dead space. This resulted in a "stimulated tidal volume" of 1360 cc if a 1000 cc dead space were used. A 1000 cc tube, made of black rubber with an internal diameter of 3.2 cm and a length of 125 cm was therefore arbitrarily selected for patient use, because it more than doubled the control tidal volume. (See fig. 1) With the nostrils occluded either by the fingers or by a nose clip, the patients respired through this tube, using a Collins rubber mouthpiece connected to the tube by a metal joint.

*the symbol pCO_2 (or pO_2) is read, "partial pressure of CO_2 (or O_2)"

Figure 1. 1000 cc. rubber "added dead space" tube with rubber mouthpiece and metal connection.

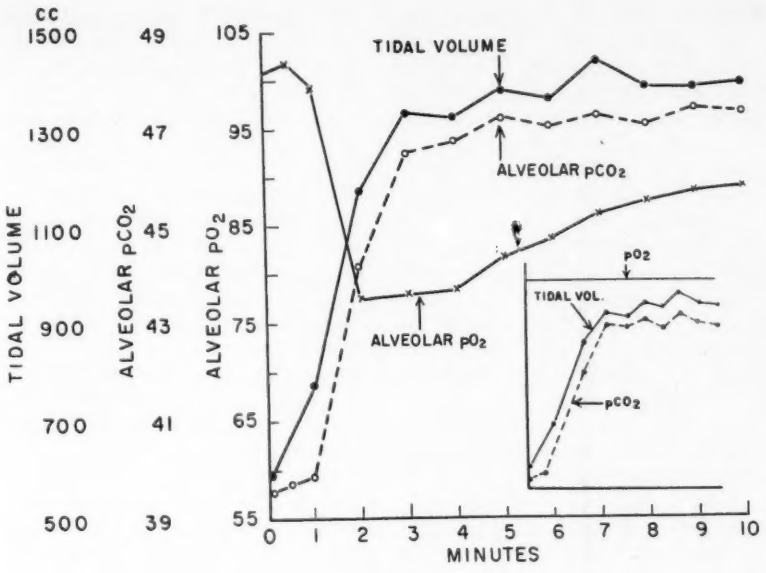


Figure 2. Average of 15 normal subjects breathing room air through the 1000 cc. "added dead space" tube showing the relationship between tidal volume, alveolar pCO_2 and alveolar pO_2. Note the decrease in alveolar pO_2 when breathing room air (main graph) and the maintenance of normal alveolar pO_2 in 3 subjects when 3 to 4 liters of oxygen per minute were introduced into the distal end of the tube (insert).

Fourteen patients who underwent various surgical procedures were studied. Control tidal volumes and "stimulated tidal volumes" (with the addition of the 1000 cc dead space) were measured. Readings were taken pre-operatively and on the first three postoperative days. In all fourteen patients, the addition of the 1000 cc dead space approximately doubled the control volume preoperatively, and more than doubled it on the three postoperative days. There was no significant alteration of the respiratory *rate*. Tidal volumes, alveolar oxygen and carbon dioxide partial pressures were measured during a 5 minute control period and during 10 minutes of breathing through the added dead space.

These measurements were plotted on a graph, and the pCO_2 and tidal volume curves closely paralleled each other (see fig. 2). The greatest increment of "stimulated tidal volume" occurred during the first two minutes, during which time it increased from a control value of 596 cc to 1188 cc. During the third minute, there was a smaller but nevertheless significant increase in tidal to 1344 cc. From the third minute through the tenth

minute, there was little change in the "stimulated tidal volume." Similarly, the greatest rise in alveolar pCO_2, from the control value of 39.44 mm mercury to 44.17 mm, occurred during the first two minutes. A second increase, from 44.17 to 47.20 mm mercury, was noted between the second and fifth minutes, and for the remainder of the ten minutes, the alveolar pCO_2 remained stable.

The partial pressure of *Oxygen* in the alveoli sharply diminished from the control value of 100.5 mm mercury to 77.61 mm during the first two minutes of hyperventilation, and over the remaining eight minutes steadily and gradually rose to 88.93 mm. If a flow of 3 to 4 liters of oxygen per minute was introduced into the distal end of the breathing tube, the average increased tidal volume and pCO_2 values were similar to the changes noted in the previous study. However, in this situation, pO_2 was maintained *above* the control value of 100.5 mm mercury. This indicates that while breathing through the 1000 cc of extra dead space, the elevation of the pCO_2 is the critical factor causing increased tidal volume.

Hyperventilation, with its attending pulmonary distension, has been considered an important factor in prevention of atelectasis. An increase in alveolar pCO_2 raises arterial pCO_2, which by central nervous system stimulation causes hyperventilation. The addition of 1000 cc dead space to the respiratory passage causes a significant rise in pCO_2 in the alveoli, and therefore effectively increases the respiratory volume.

Rebreathing the patient with such dead space tubes is presently being used throughout the Strong Memorial and Rochester Municipal hospitals in a program directed toward the prevention of atelectasis. A five minute rebreathing period every one to five hours has been initiated, and subjectively patients have found this method easier than either the paper bag or 5% CO_2 via face mask. While the nurse pinches the patient's nostrils shut, he needs only keep the rubber mouthpiece in his mouth and no additional cooperation is required.

The tidal volume is doubled by the end of the three minutes of rebreathing, equilibrates at this point and then remains stable. The patient therefore is actually rebreathing a "stimulated tidal volume" of two times his unstimulated volume during the last two minutes of this period. The marked decrease in alveolar pO_2, which rises again after two minutes, is ordinarily well tolerated by the patient. In those individuals in whom anoxia is a concern, a flow of 3 to 4 liters of oxygen per minute can be directed into the open end of the rebreathing tube, resulting in the maintenance of a normal pO_2 while hyperventilation is being accomplished. This constitutes another distinct advantage over the paper bag method, in which there is constantly decreasing alveolar pO_2.

Remember the ANNUAL MEETING

The 1956 Annual meeting of the American Association of Inhalation Therapists will be held in New York City at the Park Sheraton Hotel, November 12-16. Plan to attend.

A Simple Test - - - - - - - - - - -

will your tents pass it?

By JOHN R. GREENE

THERE IS A METHOD of determining, in advance of placing a tent on a patient, the concentration of oxygen which you can expect to maintain for the patient. This method is known as a mechanical test of oxygen concentration.

The test consists merely of tying the canopy closed, setting the liter flow at twelve liters of oxygen per minute, and testing the concentration in thirty minutes. Four-fifths of the indicated concentration may be considered the concentration which can be maintained for the patient.

A few years ago, when we first began these tests in our service, we were frankly quite shocked over some of the low readings obtained. Since that time, we have made a practice of performing mechanical tests on all tents once every three months. If a tent does not test 70 per cent, it is immediately removed from service and overhauled. If it cannot be made to test 70 per cent or higher, it is replaced. Our ultimate aim is to replace all tents that do not test 90 per cent or higher.

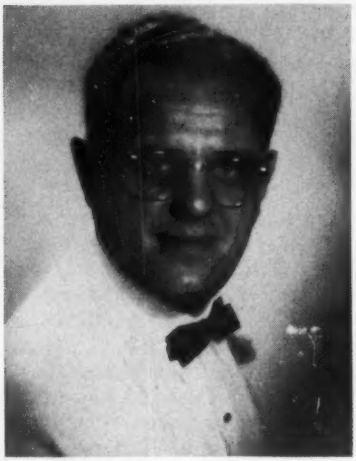
A tent that tests 60 per cent or less cannot possibly produce anything but moderate to low concentration for a patient. It is appalling to think of the hundreds of tents in use today that will test less than 35 to 40 per cent oxygen.

One of the first rules of thumb that a technician seems to learn is that the oxygen concentration in a tent rises about 1 per cent per minute. Knowing this, he is quite content if his readings are averaging 50 per cent. If the readings are less, he invariably places the blame on lack of cooperation received from the doctors, nurses, and patients. This rule of thumb is not only of little value but dangerously misleading. Tents that test only 60 per cent will never maintain 50 per cent on a patient. Tents that test 90 per cent will reach 50 per cent in only a few minutes. In fact such a tent will maintain a concentration of over 70 per cent with comparative ease and will maintain 50 per cent at greatly reduced liter flows.

Remember the formula $X=4/5M$; where X equals the concentration the tent may be expected to maintain for the patient, and M equals the concentration obtained on a mechanical test. Never use a tent that will not test 70 per cent or higher.

In our opinion this test is one of the most important duties to be performed by an oxygen therapist. When he begins routinely to provide his patients with therapeutic concentrations of oxygen, he will discover how well behaved they become and how seldom they will require professional attention. Mechanical testing is the key to better cooperation on the part of the hospital administration and staff towards the Oxygen Therapy Department.

Know Your Directors



Dr. Max Sadove
Member, Board of Advisors, AAIT
Prof. of Surgery and Head,
Dept. of Anesthesiology
Univ. of Ill. College of Medicine
Chicago, Illinois

Dorothy Braeger
Board Member: AAIT
Supervisor
Inhalation Therapy Dept.
Milwaukee Hospital
Milwaukee, Wisconsin

In each of the first four issues of Inhalation Therapy it is planned to show pictures of some of the Officers or Directors to enable the members to become familiar with these leaders.

Dr. Edwin Levine
Member, Board of Advisors, AAIT
Medical Director, Titus Werner Clinic
Edgewater Hospital
Ass't Prof., Clinical Medicine
Chicago Medical School
Chicago, Ill.

Paul N. Price
Board Member: AAIT
Supervisor
Inhalation Therapy Dept.
Methodist Hospital
Indianapolis, Indiana

Inhalation Therapist's Holiday

By Robert L. Kruse

AT THE LAST AAIT meeting, I was handed some really "tall tales" about southern weather and southern inhalation therapy, so I decided to take my vacation in the sunny south and investigate these claims for myself.

I left for Atlanta, Georgia, on January 22nd. Never have I been received more warmly than I was by Bill and Chris Stansell there. Having known them from two previous AAIT conclaves, we had quite a little to talk over. This started at one of the country's biggest drive-ins, situated alongside the scenic campus of Georgia Tech. From there, we toured all the hospitals and points of major interest in Atlanta. This took two days, as we spent considerable time in the various hospitals the Stansell company services.

Hospital Calls

Their men start out in the morning by calling on all oxygen patients in a hospital. They change catheters, IPPB units, replace masks, service tanks, tents, anesthesia equipment, and completely run the inhalation therapy department in the hospital. After a man finishes these rounds in one hospital, he proceeds to the second on his list.

When no technician is in a hospital serviced by the Stansell company, the emergency oxygen requirements are well cared for. On every floor at various locations is a closed box on wheels, containing one E cylinder, gauge and mask. Since the company is geographically close to all the hospitals, it is very easy to have a truck out to any one of them within an hour.

Bill and Chris live across the street from their 24-hour office and showroom, where their doors are never locked. This isn't a life which most people would care for, but I know the satisfaction they enjoy in owning such a company. Bill lectures to the doctors in the area, and together they have edited some films for nurse instruction.

Among other hospitals, we saw the new Piedmont Hospital, which is nearly completed, and com-

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Editor's Note: Mr. Kruse's little vacation trip, besides affording him a wonderful time, has provided us with some very interesting facts and observations about how inhalation therapy is being conducted in Atlanta, Tampa and Miami. We think these should be of interest to readers in other parts of the country.

As a matter of fact, this sort of information is just the kind we need in order to keep our own departments abreast of new developments in equipment, techniques and methods of management, etc. But since none of us has time nor money to travel more than occasionally, it would take us a long time to amass very comprehensive information of this type covering the whole country. So it is the plan of this journal to substitute a *Questionnaire* for this travel or first-hand experience; and we expect to send one out within the next few months.

The responses to this (which we will publish) will make available to our readers a mass of information such as no single individual could otherwise obtain, and as such should be of great value to all. We hope, therefore, that you will devote time, thought and care to the preparation of your replies.

pletely piped for oxygen. Bill's company will service it when it opens.

My next stop was Tampa, where I visited Dick Mann's Oxygen Therapy Service. When I called Dick about 11:30 p.m., his wife informed me that he was out setting up three tents at the local hospital. I met Dick next day, and we went through his very interesting place of business. His service covers all of Tampa for home patients, and Tampa hospital. Since this is the only general hospital in Tampa, Dick's service is plenty busy.

His uniforms are very attractive, with bright green jackets over a white suit. In the hospital, his men give all of the IPPB treatments, service and change tanks on the tents, and give lectures on oxygen techniques. Dick specializes only in inhalation therapy, so they have a complete line. He is very interested in pulmonary function tests, and works many hours every week with one of the local doctors on these tests. Also, he has been measuring vital capacities on his patients before and after IPPB and other treatments.

Again I was royally treated by a fellow AAIT man, and although I felt like back home at work while going around with Dick, it was wonderful to find another so interested in the same work. Besides seeing Tampa, St. Petersburg and Dick's set-up, we took an early evening trip down to Sarasota to set up a new IPPB unit.

The red carpet was rolled out for me again in Miami, when Max Glasser picked me up and took me off to visit his hospitals. In order to describe Mr. Glasser fully, I rely on his own remark at last November's AAIT meeting, when he said, "Bob, I want to talk Oxygen so much that everyone will immediately recognize me as a tank of oxygen." Max lived up to this statement: no matter where we were, the topic was the same!

Max's business extends farther than mere humans: he also operates

AAIT member Bruce Boyd with some of the equipment he uses at Jackson Memorial Hospital in Miami, Florida.

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a Professional Veterinary Service, featuring a very complete line of oxygen equipment for dogs, cats, horses and the like. I was very intrigued with the aerosol masks and pressure units which they have for horses. He also uses a newly designed oxygen truck which is unique. Its compartments carry a full assortment of inhalation therapy equipment, so that their drivers can give immediate service with any type of therapy to a customer when they are in an area.

The Miami hospitals are all very similar, inhalation therapy-wise. They all had departments of inhalation therapy. In the larger ones, several technicians would be on days (I speak of 100 to 200 beds as being large). In the smaller hospitals, the inhalation therapist also did orthopedic work, and ran that department. I was surprised at the large amount of equipment these hospitals have—especially tents and IPPB units. Most of the departments have their own washing machines, just for their tent canopies!

During this trip, I was experimenting with a new electronic flash gun for my camera. As a result of this, pictures taken in Atlanta and Tampa did not come out well, but I am including one of Bruce Boyd taken at Jackson Memorial Hospital, with one of their IPPB units.

At Jackson Memorial, I was overwhelmed with the equipment placed in various rooms. The largest one (about 25 by 125 ft.) included such masses of apparatus as 20 oxygen tents, 11 IPPB units, 13 demand type masks, 14 Croupettes, 140 regulators, 36 various style large aerosol generators, and so much other accumulation of inhalation therapy equipment that I thought I was in a factory! Bruce has about 11 men in his department. All regulator parts are stocked, and they have a repair man who does all their regulator reconditioning.

After nearly a week thus used in visiting fellow therapists, I was joined by my wife, and the business of basking in the sun and catching king fish began. It was a wonderful vacation, and I learned more about a very interesting business, thanks to Bill, Dick, Max and the other therapists they introduced me to.

Association News Briefs

Greater Chicago Chapter

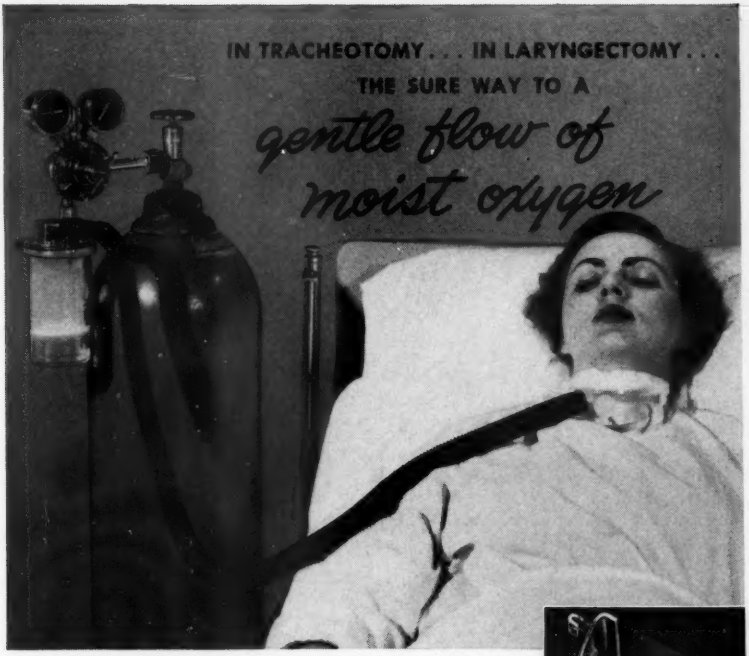
On March 16th a group of sixteen interested individuals met at the University of Illinois Research Hospital to take steps to form a Greater Chicago Chapter of the AAIT. There were therapists from a number of hospitals, and representatives of various gas suppliers, equipment manufacturers and sales and rental agencies present.

The group elected as temporary officers Gareth Gish, Chairman of the Chapter, and Robert Kruse, Secretary.

Meetings are to be held at 4:30 p.m. on one Friday of each month. The second was April 13th.

Florida Inhalation Therapists Association

The San Juan Restaurant of Miami, Florida, was the scene of the annual installation of officers of the FITA on April 11, 1956. Officers are now as follows: Max Glasser, President; Robert Stott, Vice President; Lewis B. Garrett, Treasurer; Bruce Boyd, Secretary; and Norman Rush, Sergeant at Arms.



These new NCG masks, used with an NCG nebulizer and large bore corrugated tubing, assure the soft, rolling supply of moist oxygen that is so necessary when nasal passages are by-passed. They completely cover the opening into trachea or larynx, to allow a high concentration of oxygen and humidity to be administered.

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INHALATION THERAPY ABSTRACTS

"Acute Pulmonary Edema," by Drs. A. A. Luisada and L. Cardi, in *Circulation,* 13:113 (Jan. '56).

This is an excellent comprehensive article on the physiology and pathology involved in pulmonary edema and its causes, together with a discussion of its clinical management in patients having different illnesses with which it is frequently associated.

In addition to a number of drugs which may be used to help control this often-fatal complication of cardio-respiratory disorders, these doctors (who have made an extensive study of the subject at the Chicago Medical School Division of Cardiology) point out that *anti-foaming therapy is of great benefit in all cases,* and may be life-saving. (By anti-foaming therapy is meant the use of certain anti-foaming agents such as alcohols and silicones in aerosols which reduce the frothing of secretions in the lungs.)

It is pointed out that patients with pulmonary edema fall into two groups: (1) those having high blood pressure, full pulse and good cardiac output, and (2) those with severe fall in blood pressure and low cardiac output, definitely predisposing this group toward shock.

Many of the frequently employed drugs (morphine, mercurial diuretics, sympatholytics, aminophylline) and pressure breathing are helpful with group 1 patients, but very detrimental to class 2 ones, because they all usually lower blood pressure and push the patient farther in the direction of shock. The anti-foaming therapy, however, has no effect either way on the cardiovascular system, getting in its effect entirely locally with lowering of the surface tension of the froth, breaking the bubbles and reducing the volume of foam in the lungs, thus exposing more alveoli for oxygen uptake.

"This procedure has been shown to be of definite value and *should be used routinely as the first remedy,* even preliminary to a brief study of the case. Drug therapy and other physical measures should be employed later, after an evaluation of the clinical picture, and especially if anti-foaming therapy fails to terminate the attack." (Italics ours.) (Quoted by permission of the authors and Grune & Stratton, publishers of *Circulation.* See reference at head of abstract.)

"Structure of Respiratory Tissue," by F. D. Bertalanffy et al, in *Lancet* (31 Dec. '55)

Bertalanffy's group claims, by electron microscope and histochemical means, to have settled the argument about structure of alveolar wall. They say it is **not** merely juxtaposed pulmonary capillary walls, but that it is composed of an extremely attenuated squamous epithelium, underlaid by a basement membrane of connective tissue cells in various stages of development. Many are reticulo-endothelial cells,

having ameboid and phagocytic properties. Also, they desquamate into the alveoli and are washed up and out of the respiratory tract by cilia and secretions; and they say that this loss is replaced by continuous mitotic activity among these cells, the entire stock of which is replaced about once a week.

"The Use of Enzymes and Wetting Agents in the Treatment of Pulmonary Atelectasis," by Drs. Camarata, Jacobs and Affeldt, in *Diseases of the Chest*, 29:388 (April 1956).

These doctors feel that previously reported "reactions" to enzymes have been over-emphasized, and say that in a series of over 10,000 cases they treated with "Tryptar," the only reactions noted were mild flushing and sensations of heat in the face of four patients. However, they give prophylactic doses of Benadryl 30 to 45 minutes prior to the aerosol administration of the enzyme, which no doubt is part of the reason for their success. They also say that they think what many have mistaken for reactions to enzyme therapy has been due to flooding of the tracheobronchial tree with liquefied secretions which were not then properly removed.

The wetting agents they used were Alevaire at first and then Triton A-20, supposedly merely a stronger concentration of the same detergent in Alevaire. They greatly favor the Triton A-20.

They emphasize that it does little good to liquefy secretions with these agents if the secretions are not then promptly removed. Patients with cough reflexes but who will not cough are made to cough by means of tracheal suction catheter; polio patients or others with depressed or absent cough reflex are made to cough by means of extra negative pressure supplied to iron lung by vacuum cleaner and then suddenly released, or by manual compression of the thorax during expiration.

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